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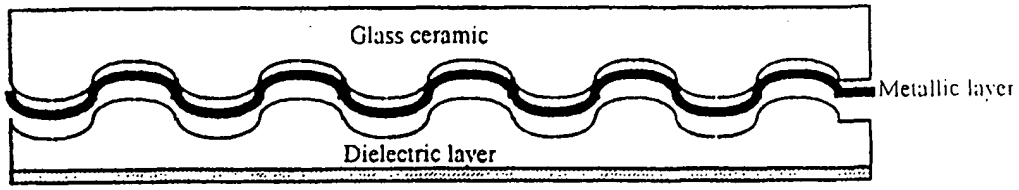
(54) Title: AN INSULATED THIN FILM HEATER



Film heater

(57) Abstract

The invention addresses the problem of insulating a glass–ceramic so that no dangerous voltages occur due to heat–provoked increasing conductivity of the glass–ceramic when it is connected to a mains supply. By intercalating a suitable stress–absorbing layer it is possible to deposit a stable insulating layer.

thinspc

An insulated thin film heater.

The invention relates to a domestic cooktop heater of the type comprising an electrically insulating substrate connected to a thin film electrical heater.

A domestic cooktop heater of the above type may be made of a (typically) glass-ceramic substrate joined to a thin film electric heater. This film heater may be either deposited onto the substrate, printed onto it or just brought into intimate contact with it. When it is energised, the heater transfers heat to the substrate by conduction (it is not desired that the contact be so loose that radiation is involved), and in turn the substrate transfers heat to the cooking utensil.

Existing glass-ceramic is known to be electrically conductive at the operating temperature, and since the user may touch a metallic cooking utensil or even the surface, it is necessary to provide an electrical insulation between the electrically heated film and the cooktop surface. At the operating temperature IEC regulations set a minimum break-down voltage requirement at 3750V AC (or 1250V AC if a grounded connection is interposed between the film and the cooking utensil). A film heater in this construction must hence comprise a specific electrically insulating layer.

Various solutions have been proposed in the past, however, no solution is presently available commercially for bonding any known high temperature electrical insulator to a glass-ceramic substrate with the capability to withstand thermal cycling from 20°C to 400°C providing a commercial life-time for the cooktop. The thermal coefficient of expansion of a glass-ceramic is near zero, and this puts a heavy requirement for any material it is desired to adhere to such a substrate. It should either present a similar low thermal coefficient of expansion or tolerate the resulting stresses. Under no circumstances must cycling provoke cracks in the glass-ceramic.

According to the invention, heater comprises a dielectric material having the requisite insulating properties at the operating temperature which is applied to the glass-ceramic, and the thin film heater is deposited onto the dielectric layer. The dielectric material is adhered to the glass-ceramic, effectively filling the unevennesses in the glass-ceramic surface and providing a smooth surface for the film heating element even though The top surface of the glass ceramic may present protrusions or dimples. In this arrangement, the heat conduction through the dielectric material is large.

According to an advantageous embodiment of the invention, the lower surface of the glass-ceramic is provided with a large number of minute protrusions, thereby effectively increasing the contact area between the glass-ceramic and the dielectric layer.

In a further advantageous embodiment of the invention, the dielectric layer and the glass-ceramic is intercalated with a heat-conductive substance which displays flow characteristics characteristics to effectively fill any voids. This means that this layer may take up any stresses occuring due to different thermal expansion.

According to a further embodiment of the invention, the substance of the intercalated layer is metallic. Such a metallic layer may be deposited directly onto the glass-ceramic, and the dielectric layer is then brought into intimate contact with the metallised surface of the glass-ceramic as above.

In a further advantageous embodiment the intercalated metallic layer has a perforated structure permitting the absorption of thermal stresses.

In a further advantageous embodiment the intercalated metallic layer is connected to ground. This has the distinct advantage that according to IEC the demands on the insulating properties of the dielectric layer are considerably reduced, because the construction now fulfils the condition of grounding. The intercalated metallic layer may be deposited by any known means, and its terminal may be brought out

on the far side of the heating element, permitting a ground connection at a safe distance from the heating element which carries the mains voltage.

The invention will be described in detail in the following with reference to an example and drawings, in which

Fig. 1 shows a section through the essential layers of the invention, i.e. the glass ceramic with its irregularities at the bottom, the dielectric layer, and the film heater layer.

Fig. 2 shows a section through an embodiment employing an intermediate, void-filling layer,

Fig. 3 shows a section through an embodiment employing an intercalated metal layer which is grounded, and

Fig. 4 shows a section through an embodiment in which the metal layer is in the form of a perforated metal foil.

In all the figures, the glass ceramic layer in practice has a thickness which is several orders of magnitude larger than the thickness of the dielectric and film layers indicated. As shown in Fig. 1, in order to increase the contact area between the glass ceramic having a zero thermal expansion coefficient and the dielectric the glass ceramic is advantageously prepared so that it has a vast number of small protrusions at its lower side, irrespective of any profiling or other surface treatment of the top surface. Increasing the surface area combined with the angles created with respect to the average surface will contribute to increasing the adhesion between the surfaces. The dielectric layer is provided in any industrially economical manner, however there is no need to obtain a flatness which is greater than that required for the following deposition of the thin film heater. The dielectric layer only has an insulating function with respect to high voltage, and this must not be obtained at the expense of increased thermal resistance. However, in case the dielectric layer has sufficient heat transfer properties, it will not only conduct heat

from the heater to the glass ceramic but will also distribute heat "sideways" and thus contribute to an even temperature distribution.

In Fig. 2 is shown an embodiment in which it is not the dielectric layer which has to comply with the surface irregularities but an intercalated void-filling layer. Such a layer may be optimised for this property and for heat conduction, and hence the dielectric layer may be optimised with respect to its electrical insulating properties. In this case, the surface presented to the deposition of thin film will be absolutely flat.

In Fig. 3 is shown an embodiment in which a metallic layer is performing a bridge between the glass ceramic and the dielectric layer. The metallic layer is required to be able to conduct to ground any leakage current passing through the dielectric layer in case it suffers a local breakdown. The conductivity of the metallic layer must be such that the potential on the upper side of the hot glass ceramic will be below ca. 40 V. This applies in the situation where this potential is obtained as a voltage division between the impedances constituted of a person and the metallic layer.

In Fig. 4 is shown that the metallic layer is constituted of a metal foil which is perforated (shown as a broken solid curvaceous line). A metal foil will be able to carry a heavier leakage current to ground than a thinly deposited layer, and also perforation is simpler to carry out as a process separate from deposition. The same function may be obtained by means of a metal mesh, and the process of manufacture of this type of layer may be by means of sputtering, screen-printing, woven metal threads or punching from a metal foil.

A further advantage associated with a metal mesh is that the capacitive coupling between the film heater and the ground plane will be much lower than with a continuous ground plane, because the electrode area will be significantly smaller when a mesh is used.

PATENT CLAIMS

1. A domestic cooktop heater of the type comprising an electrically insulating substrate connected to a thin film electrical heater characterised in that it further comprises a dielectric material having the requisite insulating properties at the operating temperature which is applied to the glass-ceramic, and the thin film heater is deposited onto the dielectric layer.

2. A cooktop according to claim 1, characterised in that the lower surface of the glass-ceramic is provided with a large number of minute protrusions,

3. A cooktop according to claim 1 or 2, characterised in that the dielectric layer and the glass-ceramic is intercalated with a heat-conductive substance which displays flow characteristics to effectively fill any voids.

4. A cooktop according to claim 3, characterised in that the substance of the intercalated layer is metallic.

5. A cooktop according to claim 4, characterised in that the intercalated metallic layer has a perforated structure permitting the absorption of thermal stresses

6. A cooktop according to claim 4 or 5, characterised in that the intercalated metallic layer is connected to ground.

7. A cooktop according to claim 5 and 6, characterised in that the intercalated metallic layer is in the form of a metal foil.

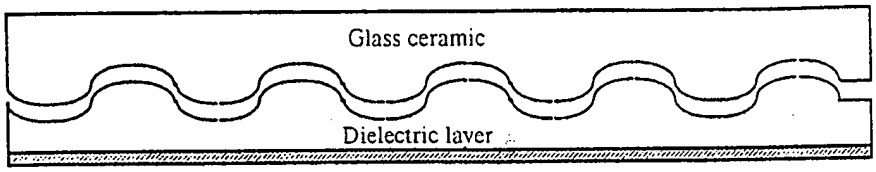


Fig. 1.

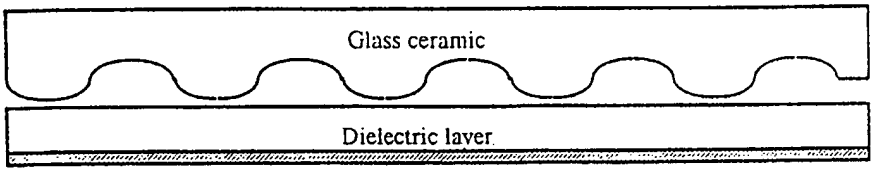


Fig. 2

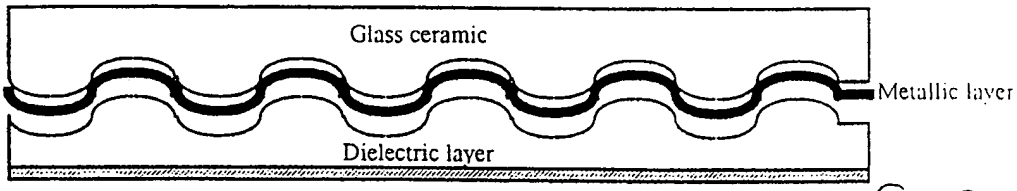


Fig. 3

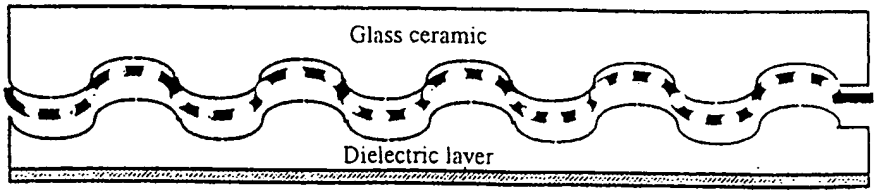


Fig. 4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 99/00466

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H05B 3/74, F24C 15/10, F24C 7/04 // H05B 3/20
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H05B, F24C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 3105065 A1 (LICENTIA PATENT-VERWALTUNGS-GMBH), 19 August 1982 (19.08.82), page 2, line 3 - line 17; page 3, line 16 - page 4, line 20, figure 1	1-6
X	DE 4109569 A1 (BUCHTAL GMBH), 24 Sept 1992 (24.09.92), column 2, line 30 - line 58, figure 1	1-6
P,X	DE 19711541 A1 (AKO-WERKE GMBH & CO KG), 24 Sept 1998 (24.09.98), column 4, line 6 - line 24, figures 3,4,5,6	1-5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E,X	EP 0951202 A2 (BSH BOSCH UND SIEMENS HAUSGERÄTE GMBH), 20 October 1999 (20.10.99), column 1, line 41 - line 56, figure 1	1-6
X	US 3694622 A (BENTLEY), 26 Sept 1972 (26.09.72), column 3, line 6 - line 61, figure 3	1
X	US 5508495 A (YAHAV ET AL), 16 April 1996 (16.04.96), column 1, line 1 - line 10; column 3, line 35 - column 4, line 10, figures 3A,3B,3C	1
X	US 3869596 A (HOWIE), 4 March 1975 (04.03.75), column 3, line 11 - line 35, figure 3	1
X	US 4032750 A (HURKO), 28 June 1977 (28.06.77), figure 4	1
X	US 5252809 A (DEMIN), 12 October 1993 (12.10.93), column 3, line 24 - line 41, figure 1	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/11/99

International application No.
PCT/DK 99/00466

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3105065 A1	19/08/82	NONE	
DE 4109569 A1	24/09/92	NONE	
DE 19711541 A1	24/09/98	EP 0866641 A	23/09/98
EP 0951202 A2	20/10/99	DE 19817194 A	21/10/99
US 3694622 A	26/09/72	NONE	
US 5508495 A	16/04/96	AT 153210 T	15/05/97
		AU 7800891 A	16/04/92
		CA 2051861 A,C	16/04/92
		DE 69126088 D,T	18/12/97
		EP 0481162 A,B	22/04/92
		ES 2031799 T	01/10/97
		IL 95988 D	00/00/00
		JP 5101870 A	23/04/93
		NZ 238348 A	23/12/93
		PT 98218 A,B	31/08/93
		US 5221829 A	22/06/93
		US 5374807 A	20/12/94
		IL 97117 A	18/08/93
US 3869596 A	04/03/75	NONE	
US 4032750 A	28/06/77	AU 2240777 A	13/04/78
		CA 1066343 A	13/11/79
		DE 2712881 A	06/10/77
		FR 2345884 A	21/10/77
		JP 52125068 A	20/10/77
		SE 7703220 A	27/09/77
US 5252809 A	12/10/93	EP 0501010 A	02/09/92
		JP 5198356 A	06/08/93